PAPERS READ.

A MONOGRAPH OF THE AUSTRALIAN SPONGES.

By R. von Lendenfeld, Ph.D.

Part V.

THE AULENINÆ.

Plate XXVI. to XXXV.

III. ORDO. CERAOSPONGIÆ. Bronn (1).

SPONGIÆ WITH A SKELETON COMPOSED OF HORNY FIBRE. SILICEOUS SPICULES PRODUCED BY THE SPONGE ITSELF MAY OCCUR IN THE GROUND SUBSTANCE, FLESHSPICULES, BUT NEVER WITHIN THE FIBRES.

I.—SUB-ORDO. MICROCAMERÆ.

CERAOSPONGIÆ WITH SMALL SPHERICAL CILIATED CHAMBERS.

The study of a great many forms has led me to consider the size and shape of the ciliated chambers as a more important characteristic, than the structure of the horny fibre, whether solid or filled with pith. To express the mutual relationship of the horny sponges according to this idea, I divide the Ordo Ceraospongiæ into the two Sub-orders Microcameræ, with small spherical; and Macrocameræ, with large oval ciliated chambers. To the first Sub-order I reckon the Spongidæ, Aplysinidæ and Hircinidæ, and to the second the Spongelidæ and Aplysillidæ.

(1) *Bronn.* Classen und Ordnungen des Thierreiches, Porifera 1ste Auflage.

11. FAMILIA SPONGIDÆ. F. E. Schulze. (1)

Ciliated chambers small and hemispherical to spherical. Communication of inhalent lacunæ with the chambers by means of numerous pores in the latter. Communication of the exhalent canals and lacunæ with the chambers by means of wide pores or canals. Fibres forming a network. Granular axis of fibres very thin. The main (radial) fibres often contain foreign bodies. Numerous granules are usually present in the gallert around the chambers and render that part of it more or less intransparent.

I. SUB-FAMILIA AULENINÆ. R. v. Lendenfeld. (2)

Spongidæ, the body of which forms a reticulation of fibres or lamellæ of a honeycomb-like structure. The lacunæ in the intervals are either simple or traversed by membranes, but in any case appear as a kind of vestibule, inasmuch as the outer surface of the fibres and lamellæ mentioned above is homologous to the outer surface of other sponges. These lacunæ belong neither to the inhalent nor the exhalent canal system, and both these systems open into them indiscriminately.

The free parts of the surface are often protected by thick layers of sand forming a dermal layer, which in some cases can be pulled off intact (Halme.)

The skeleton consists of very slender and transparent connecting fibres, which are free from foreign bodies, and thick radial fibres with uneven surface, filled with sand, &c.; or there are no such "main" fibres at all, and we find at the joining points of some of the ordinary slender fibres, large grains of sand. (Aulena fig. 21.)

The ciliated chambers are very small and spherical.

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(1) *F. E. Schulze.* Untersuchungen über den Bau und die Entwickelung der Spongien VII., Mittheilung; die Familie der Spongidæ. Zeitschrift für wissenschaftliche Zoologie, Band XXXII., Seite 593.

(2) *Auleninæ.* Name derived from the genus Aulena, Greek root. See below under "Aulena."

The canal system appears very lacunose. The granules in the mesoderm are not numerous or absent. Foreign bodies are never found loose in the ground-substance. (1)

The geographical distribution of the species is a very wide one; they grow in *shallow* water.

Although some of the Dysidea described by Marshall (2), and perhaps also some species of Holopsamma described by Carter (3), may belong to my Auleninæ; I cannot place them there. Marshall's species should I think, be left in the group Dysidea, for which a Sub-family of the *Spongelidæ* might be erected. Carter's descriptions are so short that without re-examination of the type specimens their position in my classification cannot be made out with great certainty, particularly as they are not accompanied by illustrations.

The genera described by these authors (l.c.), which come near to my Sub-family, I shall now criticise :—

Psammascus (4) Marshall, is tube-shaped, and therefore very different.

Dysidea. (5) Marshall, has foreign bodies in all fibres.

Psammoclema. (6) Marshall, has no connecting fibres.

Psammopemma. (7) Marshall, is a mass of sand with "little Protoplasm."

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(1) Both *Marshall* and *Carter* described many sponges with foreign bodies in the ground-substance. I have seen similar forms, but believe that they are more rare than is assumed, as by cutting sections through such sponges which have a thick skin protected by sand, one invariably scatters many sand granules throughout the soft parts where they remain imbedded. In this way the observer may be occasionally deluded.

(2) *W. Marshall.* Ueber Dysideiden und Phoriospongien. Zeitschrift für wissenschaftliche Zoologie. Band XXXV., Seite 92 ff.

(3) *H. J. Carter.* Description of Sponges from the neighbourhood of Port Phillip Heads, South Australia continued. Annales and Magazine of Natural History. Series 5, Vol. 15, p. 211, ff.

(4) *W. Marshall.* Ueber Dysideiden und Phoriospongien. Zeitschrift für wissenschaftliche Zoologie. Band XXXV., Seite 92.

(5) *W. Marshall.* L.c., Seite 98.

(6) *W. Marshall.* L.c., Seite 109.

(7) *W. Marshall.* L.c., Seite 113.

Carter's (1) genus *Holopsamma* is described as being "without fibre," a statement which although I consider it incorrect, I must accept, as there are no figures or descriptions of details; one of the species I believe belongs to this group.

Also, Carter's *Dysidea* (2) cannot be placed in this group, as all the fibres of his species seem to contain foreign bodies.

Carter's species *Coscinoderma lanuginosum* from Freemantle, W. A., (3), and from Port Phillip Heads (4), might be comparable to Aulena. But I think it probably identical with a totally different sponge, belonging to my Genus Euspongia of which I possess specimens from Torres Straits, etc.

Among the numerous species described by other well-known authors on Spongiology, there are none which I could refer to this Sub-family, which although doubtlessly belonging to the Spongidæ as described by Schulze (5), still shows so many peculiarities, that a detailed description of the anatomy of some of the species constituting it, will be of interest.

26. GENUS HALME. (6) NOVUM GENUS.

Auleninæ which consist of very thin lamellæ. These are much and irregularly folded, and form a honeycomb-like lacunose structure. Outside the whole structure is enclosed by a lamella, which is perforated by numerous large pores, and consequently has a sieve-like appearance. This external covering lamella is identical in structure with the internal lamellæ, and appears as a continuation of these. The pores of this external lamella lead

(1) *H. J. Carter.* Description of Sponges from Port Phillip Heads, South Australia, continued. Annales and Magazine of Natural History. Series 5, Vol. XV., p. 211.

(2) *H. J. Carter.* L.c., p. 215.

(3) *H. J. Carter.* Contributions to our Knowledge of the Spongida. Annales and Magazine of Natural History. Series 5, Vol. XII., p. 309.

(4) *H. J. Carter.* Descriptions of Sponges from Port Phillip Heads, South Australia, continued. Annales and Magazine of Natural History. Series 5, Vol. XV., p. 318.

(5) *F. E. Schulze* Untersuchungen über den Bau und die Entwickelung der Spongien. VII., te Mittheilung. Die Familie der Spongidæ. Zeitschrift für wissenschaftliche Zoologie. Band XXX., Seite 593.

(6) Halme; from ἅλμη. The dirt which the sea-waters leaves behind on drying. (Od.)

into the internal system of lacunæ. The development of this lamella is subject to great variations. The pores are either round and small or they are enlarged and become polygonal, Then only narrow strips of tissue remain between them. Finally the pores may attain the size of the lacunæ below, when of course the dermal lamella as such disappears altogether. (Plate XXVI.)

The forms of the species Halme Nidus Vesparum, globosa, and micropora possess a more or less developed dermal membrane of this kind, whilst such a structure was never observed in any specimen of Halme simplex.

The shape of the Halme specimens is very variable. Massive forms and such with finger-shaped processes appear to be the most frequent ones. Halme simplex is always expanded, flat and incrusting.

In the surface both of the covering lamella and also of the lamellæ in the interior, we meet with numerous small inhalent pores of ellyptic shape, which are covered by a sieve-membrane. These lead into short and wide cylindrical inhalent canals, which open into the common subdermal cavity. Irregular and short pillars of tissue traverse the cavity and unite the skin with the inner part of the body. There is no Pseudosculum, Halme is a true Auloplegma.

The subdermal cavity is low. From its inner surface inhalent canals of irregular transverse section originate which branch in a more or less penicillate manner. All these canals seem to tend upwards. The final ramifications of the inhalent system are regular, cylindrical canals with a circular transverse section. These canals are comparatively very wide, as even the smallest have a diameter greatly exceeding that of the membranes of tissue which separate the two canal sytems.

The exhalent canals are wider than the inhalent ones. They commence with sack-shaped cylindrical branches, uniting likewise in a penicillate fashion to form the larger exhalent stems. The canals become more and more irregular the larger they get, and finally appear as irregular and wide lacunæ. The osculum is much smaller than the lacunose oscular tube, and more or less circular. The oscula are scattered irregularly all over the surface of the lamellæ.

The Halme species differ from other sponges very much in consequence of the great width of their canals, and the exceptional thinness of the dividing membranes.

The thickness of these dividing membranes is pretty uniform 0·016 mm.

In these membranes which devide the inhalent from the exhalent system we find the ciliated chambers forming one continuous, uninterrupted, dense layer. The chambers are spherical, the inhalent pores numerous and small. Each chamber possesses one circular exhalent pore, which opens into the side of an exhalent canal without a special canal. The chambers take up the whole of the thickness of the dividing membranes and have accordingly a diameter of 0·016 mm. The ground-substance is transparent and does not contain any granules. It shows in other respects the ordinary appearance of the Mesoderm of the Spongidæ. The skeleton consists of a network of horny fibre and a dense dermal layer of sand. The sand in the outer, exposed surface is very coarse and forms a thick and hard armour, which is perforated by the pore-canals. On close examination it appears that these sand-granules are attached to one another by a kind of cement, which in its optic appearance and chemical structure (susceptability to staining re-agents) shows no difference from the Spongiolin of the horny fibres. I do not doubt, that the sand-granules are actually attached to one another by Spongiolin.

On all surfaces of the internal lamellæ we find a similar armour, but this is not near so thick and consists of very much finer sand. Spongiolin-cement cannot be demonstrated here.

The fibre-skeleton rises from a basal horn-plate containing much sand. Radial main, and tangental connecting fibres are very well defined.

The main fibres ramify in a penicillate manner, copying in this respect the Canals. All the ascending branches assume the same direction further on and so appear parallel in the distal portions.

These fibres are completely filled with coarse sand and appear as sand fibres which are enclosed by a thin horny layer only. These fibres consequently have a very uneven, knobby surface; because the outer horny layer is so thin, that it is not sufficient to fill the depressions between the adjacent projecting corners of the sand-grains. The covering horny layer shows a very marked stratification, consisting of different layers of horny substance with different refracting powers. These main fibres are on an average 0·3 mm., thick and 1·5—2·5 mm., distant from one another.

The connecting fibres are free from foreign bodies and very much thinner. They attain about one tenth of the thickness of the main fibres. They are generally vertical on the main fibres, straight and unbranched. Sometimes it appears as if one of these fibres had several distinct roots, connecting it with the main fibre. It also may happen that two adjacent fibres coalesce half-way between the main fibres for a short distance. Only in this way do some of these fibres appear slightly ramified. The average distance of these fibres from one another is equal to the thickness of the main fibres.

The genus is found throughout the Australian region.

59 SPECIES.

HALME NIDUS VESPARUM, NOVA SPECIES.

HOLOPSAMMA LAMINÆ FAVOSA. Carter (1).

PLATES XXVI., XXIX.

SHAPE.

A great many sponges of very varying shape, which I have seen, correspond in their internal structure so closely, that I have combined them to the above species.

According to my idea a great many sponge specimens, which have passed through my hands belong to it.

(1) *H. J. Carter.* Description of sponges from the neighbourhood of Port Phillip Heads continued. Annuals and Magazine of Natural History, Series 5, Vol. XV., page 212.

The ordinary shape of this species is that of a more or less irregular bulb. (Plate XXVI., fig. 1), on which excrescences are aften found, these may attain the digitate shape characteristic of the variety represented in Plate XXVI., fig. 2. Often the bulbous central mass disappears altogether, and the whole sponge consists of a smaller or greater number—up to eight have been observed—of finger-shaped processes of varying length.

The finger-shaped processes are cylindrical, and generally have a very regular, circular transverse section. (Plate XXVII., fig. 5.) Rarely the sponge expands in the shape of a flat lamella attached by a small portion of the lower surface to suitable bodies in the sea.

In outer appearance our sponge represents a species of Echispidæ very frequent in Australian waters, so closely that it is often hard to tell the difference between them without microscopic investigation. It appears to me that this is a case of mimicry. The Echispid Sponge referred to is filled with sharp and dangerous spicules tr. ac., and tr. tr., and it may be of advantage to the more defenceless Halme Nidus Vesparum to imitate this better protected sponge in external appearances to escape being attacked by some rapacious animal.

Size.

The largest bulbous specimens attain a diameter of 60 mm.

The finger-shaped processes of the other variety are generally about 12-18 mm. thick, and attain a length of 70-120 mm.

The largest specimens I have seen belong to the digitate variety.

Color.

The sponge is gray with a slight violet tinge when alive. This tinge vanishes as soon as the sponge dies, and is probably caused by a fluorescence in the outer cells in a similar way as the beautiful carmoisin red of the live Aplysilla violacea. (1)

In spirits and dry, this sponge is gray, it has in fact the color of the sand which forms the greater portion of its cortex.

Color varieties have not been observed by me.

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(1) *R. v. Lendenfeld.* Ueber Coelenteraten der Südsee, Zweite Mittheilung. Neue Aplysinidæ, Zeitschrift für wissenschaftliche Zoologie. Band XXXVIII., Seite 238.

SURFACE.

As mentioned above in the diagnosis of the genus, the surface is liable to very great variations according to the development of the dermal lamella.

The whole sponge consists of a hornycomb-like reticulation of lamellæ, (Plate XXVII., fig. 4), which is enclosed by a dermal lamella. This latter is the only portion of the sponge visible from without. This lamella is perforated by numerous pores. The appearance of the surface depends on the distribution, shape and size of these pores. They cannot be enlarged or constricted by the sponge. In some specimens these pores are round, circular, on an average 2 mm. wide and 3-4 mm. apart, as in the specimen represented in Plate XXVI., fig. 1. Exceptionally these pores may be still smaller and further apart, as it is sometimes found particularly in the basal portion of the sponge. Generally however, the pores are larger and then they become polygonal, being so close together that there would be no room for them if they were round. A specimen with pores of this kind is represented in Plate XXVI., fig. 2. Here the pores measure 3-4 mm. across, and the tissue between them is only 1 mm. wide. Rarely the pores are still larger, and then of course the dermal lamella disappears altogether, as such. Then the pores are as large as the cavities in the honeycomb structure of the interior of the sponge. (Plate XXVII., fig. 5.)

There seems to be no correlation whatever between the shape of the sponge and the development of this dermal lamella with its pores.

These pores are neither inhalent nor exhalent. They are indifferent.

VESTIBULE.

The most interesting peculiarity of our sponge, to which I have already alluded above, is its structure. This is always the same, however much the shape and surface of the specimen may change.

The whole sponge is like a honey-comb covered by a beehive perforated with numerous pores. These pores, which have been described above, are in direct communtion with the spaces beneath ; they lead into them from without.

These large lacunæ in the interior are also in communication with one another by so large apertures in the dividing lamellæ that they must be considered as continuous. (Plate XXVII., figs. 4, 5.) The lamellæ between these pores are the true body of the sponge, they are irregularly bent and twisted, and on an average 1 mm. thick. This system of lacunæ connected with the outer seawater by numerous large pores is a structure different to anything hitherto known in sponges. All these lacunæ together can be very correctly designated as a vestibule or anti-chamber, and the name of the subfamily is derived from this peculiarity. Into these lacunæe the oscula open, and from them also the inhalent canals originate.

If we were to imagine an ordinary sponge to grow in very thin lamellæ, that these lamellæ coalesce in parts and form a honeycomb structure as in the beautiful and large Echispid mentioned above and that further from the free margins of the lamellæ a dermal membrane were to grow out, which surrounded each opening with a fringe of varying development; we would have a sponge before us which in this respect would be like Halme.

That, as here stated, these lacunæ do not belong either to the inhalent or exhalent system is conclusively proved by the fact, that in the surface of the lamellæ between them, both inhalent and exhalent pores are found.

The Significance of the Vestibule to the Sponge.

It is perhaps difficult to see what advantage the sponge may derive from this peculiar structure. We might assume that the *raison d'être* of it is the following :—

1. It is disadvantageous to the sponge to load its outer surface with a hard pavement of cemented sand granules, which pavement of course greatly impedes the movements of the pores, and consequently also the regulation of the water current.

2. It is advantageous to any sponge to be defended by a hard armour of cemented sand on its surface.

The effect of the combined action of these two regulatives during the ordinary course of evolution, might be the peculiar structure just described.

The portion of the sponge exposed to attacks is principally the outer lamella. It is as we shall see below, covered by an immense armour of large sand granules cemented together with Spongiolin. This cortex gives to our sponge a high degree of hardness.

The surface of the interior lamellæ is not covered by such an armour, here we only find small and loose sand granules (Plate XXVII., fig. 7.)

A differentiation in function has taken place between the internal and external portions, they both nevertheless have retained a similar internal structure : both contain the same canal system and ciliated chambers. A difference is only perceptible in the sandy cortex of the two.

It will doubtlessly strike the reader, that these Auleninæ are very similar to certain Asconidæ among the Calcareous sponges, which likewise possess an "Inter-canal system" and numerous "Pseudopores" just like our Auleninæ. I refer as an example to the Auloplegma form of Ascaltis cerebrum (1). I established the term Auleninæ without one thought of the "artificial genus" Auloplegma and only afterwards it occurred to me that Haeckel had used the same root for his name, which shows better than any description ; as it were in an intuitive manner, how very similar these structures must be.

It appears to me very likely that the Auleninæ are not developed from ordinary sponges in the manner indicated above, and that moreover they represent among the Ceraospongiæ a group similar to the above mentioned Asconidæ among the Calcispongiæ.

This is the reason why I place these Auleninæ at the beginning of this Order.

The disadvantages connected with this arrangement are very apparent. The water may pass through the canal system of the sponge proper more than once, which of course is a bad thing unless there be such arrangements in the distribution of inhalent pores and Oscula throughout the suface of the lamellæ to prevent the water which has once been expelled through an Osculum from being inhaled again.

(1) *E. Haeckel.* Das System der Kalkschwämme. Band III., Tafel 8, fig. 6.

As far as my own observations extend, I can only say that I have not seen anything of the kind. It appears to me that pores and Oscula are scattered over the surface of the lamellæ in a perfectly irregular manner.

These sponges represent aberrant forms which may perhaps have retained some peculiarities of intermediate stages between the hypothetical simple gastrula-like ancestors, and the present horny-sponges.

This appears particularly likely if we adopt F. E. Schulze's (1) hypothesis regarding the embryological development of the present highly complicated horny-sponges by a continued process of folding or plication, as an image of the phylogenetic development of horny-sponges. In any case our Aulena sponges are very interesting, and the study of their development may lead to very important results.

Canal System.

All over the surface of the sponge lamellæ; both where it is exposed to the outer world, as also, where it forms the limit of the lacunæ described above, inhalent pores are met with.

These pores have been referred to in the diagnosis of the genus above; they are oval and measure 0·025 x 0·035 mm. across. They are covered in the usual manner by a very thin and transparent sieve membrane. There seem generally to be 10-15 pores in this membrane. These can evidently be enlarged or constricted by the sponge, and generally appear oval like the pore itself. (Plate XXVII., fig. 9.)

Spirit specimens never show these pores distinctly, but I do not think that they can be entirely closed. I once had occasion to keep a specimen a few days in a natural aquarium. By squirting strong osmic acid on to its surface, without removing it from the

(1) *F. E. Schulze.* Untersuchungen Ueber den Bau und die Entwickelung der Spongien, IX., Mittheilung Die Plakiniden. Zeitschrift für wissenschaftliche Zoologie. Band XXXIV., Seite 438.

seawater, in the manner described in my paper on Australian Aplysinidæ (1), I obtained the specimen figured, and I think that the pores in the sieve-membrane will never be much more dilated than there.

The pores in the interior are of course not surrounded by such large sand-granules as those in the outer surface, one of which is represented in the figure (Plate XXVII., fig. 9.)

Below the sieve-membrane we find a short cylindrical canal leading into the sub-dermal cavity (Plate XXVII., fig. 7, Plate XXIX., fig. 12.)

As mentioned above, these canals are liable to movements in the interior; where the skin is soft; but they do not change in the outer surface, where they are surrounded by a hard immovable cortex. Consequently we find shape and size of these canals subject to great variations in the interior where they are sometimes very much constricted and then appear very narrow, whereas those in the outer surface are always of the same size.

The cortex being much thicker outside than internally, we find these canals also much longer where they traverse the outer cortex than anywhere else.

Below, these canals expand conically and open into the common sub-dermal cavity which undermines the whole of the surface.

The flat lacunæ, which, tangentally extended and underlying the outer skin form the sub-dermal cavity are interrupted here and there by low columns of tissue connecting the skin with the body. The cavity itself is very irregular (Plate XXIX., fig. 12) and from its lower limit numerous inhalent canals originate with trumpet-shaped extensions, which mostly tend upwards (Plate XXIX., fig. 12).

These canals are rather irregular, more or less cylindrical, and measure 0·06-01. mm. in diameter.

They are mostly simple as in Aplysilla. Ramifications are only rarely met with. Where they do occur the ramification is

(1) *R. von Lendenfeld.* Ueber Cœlenteraten der Südsee. II. Mittheilung Neue Aplysinidæ, Zeitschrift für wissenschaftliche Zoologie. Band XXXVIII.

penicillate. The inhalent canals, whether ramifying or not, always taper slightly centripetally and become very regularly cylindrical towards the blind end. These canals are nearly straight and attain a length of 1—2 mm.

As mentioned above, the sponge-tissue, which divides the system of these inhalent canals from the exhalent ones, is but a very thin membrane, measuring only 0·016 mm. on an average in diameter; except where a main fibre intervenes. (Plate XXVII., fig. 7, *H.*) Divided from the parallel and straight inhalent canals by this membrane we find the exhalent canals, which are wider, measuring on an average 0·12 mm. in diameter, cylindrical and likewise, mostly straight and tending upward. These are oval or circular in transverse section. (1). (Plate XXVII., fig. 7, *e.*) Small canals, as some in this figure, are rare.

The exhalent canals unite in a penicillate manner, they are slightly more ramified than the inhalents, and finally open into a large and irregular central cavity, the oscular tube. (Plate XXVII., fig. 7, *A*; Plate XXIX., fig. 12, *O.*) Also this, like all the other canals, tends upwards and generally measures about 0·4 x 1·5 mm. in diameter, on an average it attains a length of 2—3 mm. The osculum is circular, and measures about 0·3 mm. in diameter, so that the oscular tube appears constricted at its termination. No oscula are found on the external surface. The osculum lies at the same level as the surface around, it is not raised above it.

The ciliated chambers (Plate XXVIII., fig. 11., Plate XXIX., fig. 13), fill the whole of the membrane between the canal systems as described above in the genus diagnosis. They form one continuous, dense and uninterrupted layer. Filling the whole thickness of it, they measure 0·016 in diameter, and are accordingly quite exceptionally small. They are perfectly spherical.

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(1) On the section these canals appear oval, but I think that this is due to shrinking and pressure during the complicated method of hardening, &c. I believe that in life the whole structure must be more loose, and all cavities more rounded and larger than in hardened specimens.

Numerous small pores lead from the inhalent canal into the side opposite the circular and comparatively very small exhalent pore or Chamber Osculum. Vosmaer (1), in his diagnosis of the Family Spongidæ states that their chambers are semi-sperical. This is certainly not the case here, and I take this opportunity to mention that also in several other Australian genera, which, without doubt belong to the Spongidæ as conceived by Vosmaer (l.c.), F. E. Schulze (2) and myself (3); the chambers form in a similar way much more than *half* a sphere.

The narrow pores appear very variable in size and number, and I do not doubt that they can be formed in any part of the aboral portion of the ciliated chamber constricted and closed at the option of the sponge.

The Chamber Osculum (Plate XXIX., fig. 13 *O*), appeared to me to be clothed by a peculiar flat epithelium. But with such small and delicate structures the observations are of course not very reliable. In the figure (Plate XXIX., fig. 13), I have represented this as it appeared to me. In the Aplysillidæ, I have found a different arrangement (4), which has also been seen by Vosmaer (5.) Whilst here in Halme, the ciliated cylindrical collar-cell epithelium terminates abruptly, and there is no transition between the high cylindrical elements of the chamber and the flat-cells of the canal epithelium; we find in the cases referred to (Aplysilla, etc.), cells around the inner margin of the Chamber

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(1) *G. C. Vosmaer.* Studies on Sponges. I. On Velinæ Gracilis. N. g., n. sp. Mittheilungen aus der Zoologischen Station in Neapel. Band IV., Seite 445.

(2) *F. E. Schulze.* Untersuchungen Ueber den Bau und die Entwickelung der Spongien, VII., Mittheilung. Zeitschrift für wissenschaftliche Zoologie. Band XXXII., Seite 593.

(3) *R. v. Lendenfeld.* A Monograph of Australian Sponges. Part II. Proceedings of the Linnean Society of N.S.W., Vol. IX., p. 340.

(4) *R. v. Lendenfeld.* Ueber Cœlenteraten der Südsee, II., Mittheilung Neue Aplysinidæ, Zeitschrift für wissenschaftliche Zoologie. Band XXXVIII., Seite 260.

(5) *G. C. Vosmaer.* Bronn, Classen, und Ordnungen des Thierreiches. Porifera. Seite 182.

Osculum, which are cylindrical, but do not possess a collar, and which in every respect present transition forms between the chamber epithelium, and the canal epithelium.

Skeleton.

The skeleton of the Halme Nidus Vesparum specimens observed by me is always the same however different the sponge may appear in shape and size.

Main fibres and connecting fibres are, as stated above. in the description of the genus, very different from each other.

The main fibres grow up from a basal horny plate containing much sand and tend upwards remaining in or near the centre of the sponge lamellæ. They finally curve slightly outward and ramify in a penicillate manner. The branches are as thick as the stems and in their terminal portions more or less parallel.

Comparing our sponge with others we notice that the ramification of these main fibres is but slight and that the *main fibres never hardly seem to coalesce to form a reticulation.*

The main fibres are on an average 0·3 mm., thick. The greater portion of them, the whole inner part (Plate XXVIII., fig. 8, Plate XXVII., fig. 7) is taken up by a dense mass of large sand granules held together by a Spongiolin-cement. Outside we find a thin horny layer on the surface of the sand. This is stratified and the layers are visible because the successive strata refract the light in a different degree.

This outer coating or sheath is very thin, measuring only 0·01 mm., in thickness. Consequently the surface or outline of the fibre appears very uneven as the projecting corners of the imbedded sand grains are divided by indentures, which the outer horny layer is not thick enough to fill up.

These main fibres are connected with one another by connecting fibres (Plate XXVII., fig. 8). These are very simple and as shown in the figure mostly straight, vertical to the main fibres and only very slightly ramified.

The ramifications never lead to the production of a network; only occasionally we see adjacent fibres coalescing in the middle or also a fibre divided into 2, 3 or more little branches which appear as its roots on one side.

These fibres have a thickness of about 0·02 mm. They are very light in color somewhat like glass and perfectly transparent With a high power of the microscope a very slender axial thread is made apparent, which swells to little conic granular masses at the points where the axial thread joins the main fibre.

These fibres are about 0·3 mm. apart from one another.

Also the cortex of the sponge must be considered as an integral part of the skeleton, and this all the more as we find the main fibres actually coalescing with it. (Plate XXVII., fig. 7.)

The structure of the cortex is very interesting. Some theoretical conclusions from its peculiarities have been drawn above. The sand granules forming the cortex on the outer exposed surface measure on an average 0·1 mm. in diameter, and what is very remarkable, are all of the same size.

The sand granules in the interior of the main fibres are identical in size and shape with those in the outer exposed surface, and without a doubt derived therefrom. (1) These sand granules are held together by a cement of spongiolin, and the armor they form has a thickness of about 0·35 mm.—a thickness very similar to that of the main fibres.

The canals leading into the vestibule-lacunæ are short and circular, cylindrical perforations of the external lamella. (Plate XXVII., figs. 4, 7 ; *O*.)

In the wall of these short tubes we find a very different kind of cortex. It is a transition from the cortex without to the cortex within. Near the outer surface (compare the figure) the sand grains are as large as in the outer cortex, but the layer they form is only about half as thick.

As we proceeded downward the size of the sand grains and also the thickness of the sand layer decrease rapidly, until finally we

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(1) This is in accordance with the views expressed by Carter and others.

find in the lower proximal portion of this canal, sand grains, which measure only 0·02 mm. or less on an average. (Plate XXXVII., fig. 7; *f.*) The thickness of the layer they form is only 0·5—0 7 mm. or less. A similar layer of similar sand grains is found throughout the interior surfaces of the sponge.

Growth of the Skeleton.

Whether a selection in the sandgrains, which came in contact with the sponge, by the latter, is executed in such a way as to retain the large grains on the outer surface and the small ones in the interior, cannot be ascertained, but there can be no doubt, that also without such an act on the part of the sponge the disparity in size of these elements of its cortex can be partly explained without difficulty in the sense of F. E. Schulze. (1) The large sand granules never enter the pores in the outer lamella because there is not sufficient current in the interior of the sponge to carry them along. The small ones are carried along also with the weak current in the interior, and they are then retained on the interior surfaces.

The fact however that *no small sand grains are found in the outer surface* cannot be accounted for in this way. There we must assume that the sponge exerts some voluntary selection.

As the sponge grows, the outer surface with the large grained cortex is moved more and more from the basis of the sponge and the main fibres grow after it always remaining in contact with it they derive as it were the sand we afterwards find in them from the cortex.

We can conclude from this, that the *region where the sponge grows is just below the surface.*

The connecting fibres grow out from the main fibres as room for them occurs below the receding outer cortex.

(1) *F. E. Schulze.* Untersuchungen Ueber den Bau und die Entwickelung der Spongien. Die Gattung Spongelia. Zeitschrift für wissenschaftliche Zoologie. Band XXXIII., Seite 131.

Histology.

I have not observed any thing peculiar in the structure of this sponge. It is remarkable, that *no granules* are found in the ground substance around the ciliated chambers. It is known to the reader, that the family of the Spongidæ has been defined as comprising species with such granules by F. E. Schulze (1) a definition accepted by us afterwards without alteration. If I now place these sponges in this family; I do so in consequence of a desire on my part not to complicate the classificatory system too much; and not because I think that the presence or absence of granules is a thing of little importance. I must however say that I examined several, as yet undescribed species of horny sponges which I intend to describe as Spongidæ, which likewise possess a comparatively clear ground substance.

The tenacity with which such peculiarities adhere to certain forms —the "systematic value" of them—can as yet not be ascertained because we know so very little about all these sponges.

I have found both male and female sexual products in the specimens I have examined but I cannot say whether the species is hermophroditic or not. I have never found male and female sexual cells side by side, but this of course is an observation of no value to decide this question.

Parasitic Algæ in the Skin.

In the outer skin between the hard sandy cortex and the outer surface generally, small algæ are met with, which have the shape of fine threads consisting of a string of cells. (Plate XXVIII., fig. 10.) These threads are rounded on each end.

It is connected with difficulty to find these structures, because they are of a very faint brown color and very small. I have however, been able to find them in most specimens, and I cannot say whether they do not occur also in those where I have not seen

(1) *F. E. Schulze.* Untersuchungen Ueber den Bau und die Entwickelung der Spongien Die Familie der Spongidæ. Zeitschrift für wissenschaftliche Zoologie. Band XXXII.

them. I no not think that they can be of much importance to the sponge in which they live; they are certainly very similar to those Oscillarians of which I assume that they are the cause of the formation of the filaments in the Hircinidæ. (1) The family of the Hircinidæ is a doubtful one, and before the true nature of the filaments is known, we will hardly be able to arrive at any satisfactory conclusions concerning them. I do not place very much reliance in the conclusions which might be inferred from Poléjaeff's (2) observations on the subject. I on the contrary, uphold my hypothesis referred to above, as the most likely one.

True filaments or anything like them, have not been observed by me in theHalme specimens I examined, so that I would not consider myself justified in placing this genus in the Family Hircinidæ, even if the oscillaria I found in Halme were identical with the one, which according to my idea causes the formation of filaments in the Hircinidæ.

Geographical Distribution.

Eastern Coast of Australia, Southern Coast of Australia, Port Phillip (Von Lendenfeld); Port Jackson (Ramsay, Von Lendenfeld); Port Stephens (Ramsay).

Bathymetrical Distribution.

5-20 metres. (Port Phillip and Port Jackson.)

The bulbous variety has been obtained from the three localities. The digitate variety has been obtained from Port Stephens only.

60. SPECIES.

HALME SIMPLEX, NOVA SPECIES.

Plates XXVI., XXVII.

As the structure of this species is similar with that of the foregoing it will be sufficient to give a short diagnosis of it here.

(1) *R. v. Lendenfeld.* Notes on the Fibres of certain Australian Hircinidæ. Proceedings of the Linnean Society of N.S.W., Vol IX., p. 641,

(2) *N. Poléjaeff.* Report on the Keratosa. The Zoology of the Voyage of H.M.S. Challenger. Part XXXI., p. 12.

Shape and Size.

Halme simplex is a low, incrusting sponge. The crusts are higher in the centre than at the margin and of irregular roundish outline. The regularity of the outline is often disturbed and then we find lobate extensions of varying shape and size. The crust has a thickness of 12-20 mm., and may extend to 100 mm. (the largest specimen seen by me).

Color.

The sponge is generally, alive and also when dry, of a uniform dark chesnut color. I have however seen some dried, badly preserved specimens of it, which were grey.

Structure.

The sponge consists of lamellœ which are not nearly so complicated in their plications as those of the foregoing species. The honeycomb structure (Plate XXVI., fig. 3) is more simple than in Halme nidus vesparum. The whole of the lamella appears as a portion of an irregular comb. The surfaces are curved in one direction (laterally) only, whereas they are straight in the other direction (vertically). From a basal incrusting lamella numerous upright and much curved septa or lamellæ arise between which there are large conic spaces (Plate XXVII., fig. 6). These lamellæ correspond to the *interior* lamellæ of the foregoing species. The conic spaces between them are the vestibule lacunæ. An external lamella as described above is not met with; the conic lacunæ are in open communication with the sea-water outside.

The skeleton is similar to that of Halme Nidus Vesparum and a cortical layer of sand grains is met with. This latter consists of a thick layer of large grains on the free margins of the lamellæ and of a thin layer of small grains further down in the surface near the bottom of the conic spaces. Half way up we find a cortex intermediate between the two.

It appeared to me that the skeleton in general was more coarse than in the other species, microscopic measurements, however, proved that it was not so. The sponge is not nearly so haid as Halme Nidus Vesparum. There is a great abundance of sand, but it appears that the Spongialin-cement is not so highly developed in this species as in the foregoing.

Geographical Distribution.

North Coast of Australia, South Coast of Australia, Mauritius, Port Phillip (Von Lendenfeld); Torres Straits (Macleay); Northern Territory of South Australia (Haacke); Mauritius (Von Haast).

Bathymetrical Distribution.

10-20 metres. (Port Phillip.)

The Port Phillip specimens are black when dry (brown in spirits and living). All the others light or dark brown (dry).

61. SPECIES.

HALME GLOBOSA, NOVA SPECIES.

Shape and Size.

The specimens which I refer to this species are bulbous, more or less spherical and attached by a small portion of the surface only. They measure from 30 to 60 mm. in diameter.

Colour.

In the living state this sponge has a greyish-purple color, which seems however, to be subject to unusual variations. The purple is always the same, but the grey varies according to the nature of the foreign bodies in the dermal lamella, from light to dark gray. In spirits, it preserved well, the sponge retains its dull purple color; if not well preserved, and when dry the sponge is brownish grey.

SURFACE.

The Dermal Lamella is developed in a rather different manner than in Halme Nidus Vesparum. It appears as a terminal thickening of the distal interior lamella. On sections it makes the impression of a wedge-shaped thickening. The contour of the

Pseudopores is also not so sharp as in Halme Nidus Vesparum, but more rounded. The Pseudopores themselves consequently appear from without as trumpet-shaped openings narrowing towards the interior. They measure on the surface 8 mm., and in the narrowest part a little below 5 mm. across. They are more or less circular and divided from one another by bridges about 7 mm. wide.

Structure.

In its structure our species represents a marked peculiarity in one respect only. We usually find that the wide inhalent canals, which are simple open tubes in the two foregoing species, are here pervaded by numerous fine membranes, similar in structure to those which pervade the vestibule space in the genus Aulena. These contain a great number of wandering amœboid cells, which are highly colorable and present in sections a very remarkable appearance, after Alum-Carmin staining. I believe that here in the inhalent canals we may perhaps look for the digestive operations of this sponge. It seems that the digestive functions are performed *by different parts of the inhalent system in different sponges.* I believe also to have seen in these perforated diaphragm-membranes, cells which might be considered as sensitive and ganglia cells.

Geographical Distribution.

South Coast of Australia, Port Phillip (Von Lendenfeld); St. Vincent's Gulf (Haacke).

Bathymetrical Distribution.

In shallow water.

The St. Vincent Gulf specimens are larger than those from Port Phillip.

62 SPECIES.

HALME MICROPORA, NOVA SPECIES.

Shape and Size.

This species is irregular globose with deep, rounded indentures, which divide it into lobes of varying shape and extension. Only two specimens have been seen by me, both are of equal size, measuring 40 mm. in height, and 70 mm. in breadth.

Color.

This species I have only seen in the dry state. Then it is of a bright yellow, light ochre-coloured.

Surface.

The surface is different from that of any of the foregoing species. The dermal lamella namely, is very thin and does not contain so hard and resisting an armour of cemented sand-grains as in Halme Nidus Vesparum, which species is the most like it as far as the surface-structure is concerned. Between the terminations of the interior honeycomb, which is exceptionally regular, the dermal lamella is in the dry specimens depressed. It appears as if it had collapsed. In the centre of each depression there is a small round Pseudopore. These pores measure only 1 mm. in diameter, are all of uniform width, and about 10 mm. apart, scattered very regularly over the surface.

Structure.

The internal structure is peculiar. The honeycomb structure is more marked than in any other species. On a section one perceives that the walls of the cells are straight and upright as in Halme simplex. But there are several layers of such cells, one over the other, the cells of different layers communicating with one another by small pores only. As no spirit specimens have been examined by me, the position of this sponge appears somewhat doubtful; the general appearance however, is so similar to the other species, that I consider myself justified in placing this sponge in the genus Halme. It might however, be one of the Spongelidæ.

Geographical Distribution.

East Coast of Australia, Illawarra (Ramsay).

Bathymetrical Distribution.

Both specimens were washed up on the beach near Wollongong.

27. GENUS APHRODITE. (1) NOVUM GENUS.

Auleninæ of Nardorus shape without secundary diaphragm lamellæ in the vestibule-space with a terminal Pseudosculum. Small conuli scattered all over the surface. No dermal lamella developed. The skeleton consists of radiating main fibres charged with foreign bodies and tangental connecting fibres, which have an eighth of the diameter of the main fibres, and are destitute of foreign bodies.

63. SPECIES.

APHRODITE NARDORUS, NOVA SPECIES.

Shape and Size.

The only specimen of this sponge seen by me is pyriform and pedunculate.

It reaches a height of 150 mm. The peduncle is cylindrical and circular on transverse section, perfectly straight and upright, of uniform thickness throughout, and 80 mm. long. It measures 9 mm. in thickness. On the summit of it the sponge expands in the shape of a sphere to a width of 30 mm., and tapers towards the upper end, which is crowned by the large, circular pseudosculum, which measures 9 mm. in diameter. (Plate XXXV., fig. 34.)

It represents to a great extent the figure given by Haeckel (2) of his Ascilla Gracilis Nardorus. Only the network is more dense and the surface conulated.

Color.

In spirits light yellow, greyish in the interior.

Surface.

There is as mentioned above in the diagnosis of the species, no dermal lamella, and so the interior structure is open to view from without. The Pseudopores are very irregular, elongate, pointed at each end and longitudinally disposed. All the exposed surfaces

(1) Aphrodite='Αρѕοδίτη. The Ideal of Beauty arisen from the waves.
(2) *E. Haeckel.* Die Kalkschwämme ; eine Monografie. Band 3. Tafel 6, fig. 5.

are uniformly conulated. The conuli are about 1 mm. high, and 2 mm. apart from one another. At the bottom of the peduncle the conuli are nearer to one another than further up. There is no difference in the conulation of the peduncle and head.

Structure.

With the exception of the dermal lamella, the microscopic structure is very similar to that of Halme Nidus Vesparum described above. In other respects this sponge shows greater affinities to Aulena. The true body of the sponge consists of a network of thick, cylindrical, longitudinally disposed fibres which coalesce very frequently. They measure 5-8 mm. in diameter, and form a dense network supported by the peduncle. Throughout these, as also in the peduncle we meet with a canal system and skeleton similar to that of Halme Nidus Vesparum. The inhalent pores are found abundantly on the exposed parts, whereas the Oscula are all directed inward towards the Pseudogaster. At the top of the peduncle there are several larger Oscula. There are no Oscula on the sides of the peduncle. Evidently here the Pseudogaster is being converted into a true Oscular tube, and if the apertures between the fibres of the true sponge body were filled up we would have a sponge before us with a simple terminal Osculum. The thinking reader can draw his own conclusions from these statements. It may, however, be of interest here to mention the variety in shape in a sponge which I have named Cacospongia exemplum. Over a hundred specimens of this sponge have passed through my hands, There are numerous varieties, but all are connected with one another in such a manner by intermediate forms that they altogether represent a continuous series, special forms of which have been described by Hyatt and Carter from Australian waters. In the first variety C. ex. prima, we have flat, expanded frondose forms. All the Oscula are on one side. In the second, (C. ex. secunda) we have a true cup formed by the bending and final coalescing of the lateral margins of this plate. All Oscula are on the inner side. Geelongia Vasiformis, Carter, is identical with this variety. Further the cup becomes smaller and smaller until a pedunculate pyriform sponge with numerous Oscula on the apex is produced. (C. ex. tertia.) This variety is identical with some sponges described by Carter as Stelosponges levis, Hyatt, etc., and also with Hyatt's Spongelia rectilinea errecta. Finally in quart. (C. ex. terminus) we find a pedunculate pyriform sponge with a single terminal Osculum. This shows how in various ways the same form may finally be produced, and with what difficulties the study of the relationship of sponges is beset, at the same time furnishing an example to Oscar Schmidt's statements regarding approximating development.

Geographical Distribution.

North Coast of Australia, Torres Straits, Palm Tree Island (Macleay.)

Bathymetrical Distribution.

Shallow water.

28. GENUS AULENA. (1) NOVUM GENUS.

Auleninæ, the body of which possesses the shape of a sponge-like reticulation. In the intervals between the meshes of this network a network of very fine membranes expands. The fibres of the sponge network possess the usual structure of sponges. The lacunose cavities between, which are pervaded by the membranes mentioned above, have the significance of anti-chambers. They are attached as it were to the outer surface of the true body of the sponge, and so form a vestibule.

The skeleton consists of a network of very fine horny fibres which never contain foreign bodies, are solid and transparent; and show a slender axial thread and stratified horn substance around it.

In the vestibule portion of the sponge the meshes of the network of these fibres are very wide. In the true body of the sponge about four times as small. In the true body of the sponge

(1) *Aulena* from ἀυλή the vestibule or antichamber ; with antichambers.

we find in most of the places where two fibres join, large granules of sand which exceed in diameter the fibres 5—15 fold. These grains are clothed with a fine coating of spongiolin and form an integral part of the whole skeletal system. (Plate XXXIII.)

The lacunes between the membranes are connected with one another, and the outer world by numerous large round pores. The distal portions of the true sponge-body extend in the shape of conuli in a radial direction some distance beyond the lacunose tissue. Inhalent pores and oscula occur throughout the whole of the surface of the true sponge-body. Some of these—on the projecting conuli—open direct into the outer water. Most of them, however, open into the system of lacunæ. The inhalent pores are covered with a sieve membrane, they lead into low, tangentally expanded subdermal cavities. The inhalent canals which originate from this subdermal cavity are not very large, much curved and only very slightly branched. The ciliated chambers appear spherical, and are $\frac{1}{3}$—$\frac{1}{2}$ as large as the canals, having a diameter of 0·04 mm. They open with a large circular Chamber Osculum direct, without special canal into the large exhalent canals which unite to form extensive oscular tubes. The oscula are numerous and scattered irregularly over the surface of the sponge. Nardorus and Auloplegma forms.

64 SPECIES.

AULENA VILLOSA. NOVA SPECIES.

(PLATES XXX., XXXIV.

At present the only species of the genus.

SHAPE.

This sponge is comparatively rare. The specimens which I have seen were bulbous without exception; spherical or oval. The sponge is attached to suitable surfaces in the sea by a very small portion of the surface but not pedunculate. It resembles in this respect the massive forms of Chondrosia. The sponge appears to a certain extent radially symmetrical round a vertical axis.

Size

The vertical diameter varies from 25—40 mm. Horizontally the sponge generally measures a little less than in height.

Color.

The color of the live sponge is yellowish-gray, but seems to be subject to variations. In spirits and dry the sponge appears dirty gray.

Surface.

The surface of the sponge is covered by densely situated cylindrical and terminally rounded conuli. (Plate XXX., fig. 14, 15, Plate XXXI., fig. 19, 20.) These conuli are about 2 mm. high, and 0·8 1 mm. broad; they are about 1·4 mm. apart from one another and circular on transverse section. The direction in which these conuli protrude from the surface varies to a certain extent. They invariably radiate from a common centre; but this centre may be situated further up or further down as the case may be. In some specimens this centre coincides with the centre of the sponge; then the conuli stand vertical on the surface. (Plate XXX., fig. 14), in others again, this centre lies near the base of the sponge, and then the conuli all appear to tend upward. (Plate XXX., fig. 15, Plate XXXI., fig. 20.) This makes a great difference to the appearance of the sponge, although it is immaterial. It appears that the locality where the sponge grows has something to do with the direction of the conuli, but as the specimens at my disposal are but few in number I cannot assert this.

These conuli are rather soft and may move with the current of the water. This peculiarity makes the sponge appear villous, and from that the specific name has been taken. The surface of the conuli is soft. Microscopic investigation shows that there are no foreign bodies, sand, or anything of that kind in the outer skin.

The surface in the depressions between the conuli is formed of a very fine soft and tender membrane, perforated by large circular pores which lead into the system of vestibule-lacunæ below. The Pseudoscula. when present are few in number, 1-4, circular and on the upper surface they measure 2-5 mm., in diameter.

Vestibule.

The great difference between the genera Aulena and Halme, lies not only therein, that in the former the true body of the sponge is formed by lamellæ, and in the latter by cylindrical threads ; but particularly also in the great difference in the development of the vestibule in these two.

Whilst in Halme it is a simple empty space between the sponge lamellæ ; it is traversed by numerous fine membranes in Aulena. (Plate XXXI., fig. 19, Plate XXXII., fig. 21), which sub-divide it into smaller, more or or less spherical compartments connected with one another by large circular pores in these membranes. It is apparent that by movements of these membranes the current of water can be greatly influenced, and we find that there are nervous and muscular elements contained in them by the united action of which, no doubt the water current is regulated to the advantage of the sponge.

The meshes of the network formed by the true body of the sponge measure, 7-2 mm., and this is the extent of the vestibule lacunæ.

The compartments into which the vestibule space is divided are more or less spherical and measure 0·2-0·5 mm. in diameter.

The whole structure has a froth-like appearance. (Plate XXXI., fig. 19.) This tissue fills the whole of the vacant space between the meshes of the sponge network.

The thickness of the membranes is on an average 0·017 mm. The circular pores (Plate XXXII., fig. 21), are situated in the middle of the fields limited by the lines where the membranes join.

The membranes are supported by horny fibres, which pervade the whole of the lacunose part of the sponge.

The Significance of the Vestibule in Aulena.

It is apparent that this structure although homologous to the simpler one of Halme, being very differently developed, must perform slightly different physiological function.

The first reason put forward as possible for their formation in Halme cannot hold good here, as there is no cortical lamella to the sponge at all. Also in this genus the resemblance to certain Auloplegma forms of calcareous sponges is very striking.

The whole structure may be a somewhat changed remnant of an organ previously possessed by sponges, and lost in all, except the Auleninæ. In this case we would have to c onsider Aulena as still more conservative than Halme.

I have however, no knowledge of the embryological development of either genus, so that I must leave it to the thinking reader to draw his own conclusions from the facts described.

Canal System.

The canal system of our sponge is more complicated than that of Halme, but still more simple than in most other sponges.

The inhalent pores are scattered all over the surface and on an average 0·2 mm., apart. They are circular or oval and apparently very liable to changes in shape and size, as their dimensions differ in different specimens and also in different parts of the same specimen. No regularity in these differences could be traced and I therefore believe that they are of the same size throughout the sponge and that they can be contracted and dilated at the option of the sponge.

I estimate the average diameter at 0·04 mm. Outside they are covered by a very fine and tender sieve membrane, with numerous, about twenty, circular pores. I have repeatedly found this sieve membrane absent in spirit specimens, which were preserved by myself and ought to have shown it. Possibly this is due to the extreme tenderness of it. The rapid contracting effect of the alcohol may have ruptured them.

The inhalent pore is the opening of a short, circular and cylindrical canal, about 0·04 mm., long and as wide as the pore itself, which pervades the skin of the sponge and leads into the subdermal cavity.

The latter is not so highly developed as in Halme and consists of a system of wide anastomosing canals extending tangentally and undermining the skin (Plate XXXII., fig. 21). The canals are depressed radially. The outer side is flat and forms a plane parallel to the outer surface. Below the outline of these canals is very irregular, forming wide, conic or trumpet shaped extensions which lead into the inhalent canals. The average width of this subdermal cavity is only 0·03 mm.

The inhalent canals are much curved and only slightly ramified. Their transverse section is generally more or less circular and their diameter averages about 0·18 mm.

They are accordingly very much wider than the subdermal cavity. The ramifications are irregular. Divided from the system of inhalent canals by a lamella, 0·045—0·05 mm. in thickness, we find the exhalent canals. These are much more irregular in shape than the inhalent ones (compare the figure), and of similar average width. Also these are only slightly and irregularly ramified and unite to form irregular lacunose cavities, the oscular tubes. (Plate XXXII., fig. 21.) The average diameter of these spaces is 0·6—0·8 mm. Towards the circular oscula, which are not raised above the surface and scattered irregularly all over the sponge, the cavities are constricted. The diameter of the osculum is 0·12 mm.

The ciliated chambers are spherical and very similar to those described above of Halme Nidus Vesparum. They form like those of Halme a dense layer taking up the whole of the thickness of the lamellæ which divide the inhalent from the exhalent canals. They are accordingly much larger than those of Halme, measuring 0·04 mm. in diameter.

Skeleton.

As the reader will have seen from the description of the genus the skeleton of this sponge is very remarkable. (Plate XXXIII., fig. 22.) The whole skeleton consists of a regular network of solid horny fibres which do not contain any foreign bodies. Main and connecting fibres cannot be distinguished. They are all alike as in Carter's (1) genus Coscinoderma, recently also described by Poléjaeff. (2)

The fibres are circular and cylindrical, and they have a diameter of 0·02 mm. The regular network formed by them is pretty loose. In the true body of the sponge itself the meshes average 0.2 mm. and in the vestibule tissue 0·5 mm.

At the joining points of the fibres, in the true body of the sponge only, we find sandy granules of uniform size, *one in each joining point.* (Plate XXXII., fig. 21, Plate XXXIII., fig. 22.) These measure 0·14 mm. in diameter on a average and are of a more or less spherical shape. Elongate sand grains seem never to occur.

These sand grains, which form, as it will be seen from the above, an integral part of the whole skeleton, are enclosed in a horny coating (Plate XXX., fig. 17), about half as thick as the fibres which originate from it. This coating is stratified ; but the layers are not very clearly visible.

The presence of these sand grains is rendered particularly remarkable by the fact, that no sand whatever occurs in the outer skin of the sponge. As a rule we find in the skin of such sponges which contain foreign bodies in their fibres, also similar foreign bodies, in the skin.

There can be no doubt that these sand grains are originally attached to the tips of the conuli, and from thence they *apparently* wonder centripetally because they *actually* remain in the same place whilst the sponge is growing and the conuli extend beyond them. They are then sought by the growing horny fibres and retained in their joining points.

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(1) *H. J. Carter.* Contributions to our Knowledge of the Spongida. Annales and Magazine of Natural History. Series 5, Vol. XII., p. 309.
(2) *N. Poléjaeff.* Report on the Keratosa. The Zoology of H.M.S. Challenger. Part XXXI., p. 28.

Hisotolgy.

Although our sponge does not present any interesting peculiarities in most respects, it is still remarkable for the development of its nervous system.

I have found that the surrounding of the horny fibres near the tips of the conuli are very similar to those described by me of the Australian Aplysillidæ (1). As in those we find (Plate XXX., fig. 18) a coating of Spongoblasts around the growing fibre (*S*). These are very small, measuring only 0·006 mm., in length, they are three times as high as broad. In the distal, rounded end we find a very elongate nucleus. Outside, this layer of Spongoblasts is covered by a layer of spindle-shaped longitudinal tissue cells (*B*). Here and there we find a thread formed of similar cells (*B'*) extending through the soft part of the sponge and joining the hollow cylinder formed by those tissue cells which cloth the horny fibre.

The horn fibre is clearly striated (*H*) and a granular axial canal (*A*) can be detected.

The Nervous System.

(Plate XXXIV., fig 23.)

The reader will remember, that elements of *calcareous* sponges (2), have been described by me as being nervous cells. In Aulena similar elements have been found by me, which I consider to have a nervous function.

At the joining lines of the membranes which pervade the vestibule space, where the membranes are thickened, numerous spindle-shaped cells are found in groups. These are immersed in the ground substance and vertical to the surface.

They are 0·01 mm. long, and in the middle 0·002 mm. thick. The distal end is protracted to form a short hair or cilia, a Palpocil

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(1) *R. v. Lendenfeld.* Ueber Coelenteraten der Südsee, II. Mittheilung Neue Aplysinidæ Zeitschrift für wissenschaftliche Zoologie. Band XXXVIII.
(2) *R. v. Lendenfeld.* The Histology and Nervous system of Calcareous Sponges. Proceedings of the Linnean Society. Vol. IX.

(Plate XXXIV., fig. 23, *T*), which projects beyond the surface to some distance. (1)

The protoplasm of these cells is very intransparent, and shows after treatment with osmic acid the large dark granules peculiar to the sensitive protoplasm of Hydromedusæ after treatment with the same re-agent. The nucleus is large, elongate and oval.

Below, these cells taper or widen and seem to send forth threads of Protoplasm which pervade the ground-substance.

These threads are very indistinct and only rendered visible by the large black granules imbedded in them after treatment with Osmic acid.

Below these groups of sensitive cells, we find large, and beautifully developed multipolar Ganglia cells, with numerous much ramified processes on all sides, a dark granular protoplasm and a spherical nucleus in the centre.

These elements measure 0·01 mm. across ; the nucleus has a diameter of 0·005 mm. This nucleus appears nearly black after treatment with osmic acid and picric acid carmin. (Plate XXXIV., figs. 23, *g*.)

A direct communication between the basal centripetal processes of the sensitive cells and the ramifications of the nerves which originate from the ganglia cells has not been observed by me with sufficient clearness. I think that the figure represents well what I have seen ; even with the homogeneous immersion the doubts could not be removed on this score, but *I believe* that such a connection does exist.

(1) The nervous elements can be seen in alcohol-carmin specimens, but they are much better visible in specimens treated with Osmic acid and stained with Picric acid carmin. It is necessary to make very fine sections to demonstrate these elements. The length of the Palpocil cannot be ascertained, because it naturally shrinks under the influence of Osmic acid. In the best sections I have, it projects beyond the surface about 6·002 mm. I believe, however, that it must be much longer in life. I have taken great pains to see these structures in the living state, and have drawn the palpocils according to what I believe to have seen. Anyone acquainted with the study of sponge histology will admit the great difficulty in the way of such observations, and will value the correctness of the result accordingly. This of course only relates to the *length* of the pelpocil, its *presence* cannot be doubted.

The membranes are covered on either surface by a flat Ectodermal Epithelium. (Plate XXXIV., fig. 23, *d*.) In the ground substance spindle-shaped cells are found which traverse the membranes in all directions. (*c*) I do not doubt that some of the fibres originating from the ganglia cells are connected with those elements which I consider as muscle cells.

By the sensitive cells the conditions of the water around them is felt and an irritation transmitted to the ganglia cells below. There a decision is arrived at, what should be done, provided these outer conditions and with them the nervous irritation change. The ganglia cells irritate the muscles, and so the pores in the membranes can be dilated or contracted, and the current of water changed and regulated with advantage to the sponge. Whether any consciousness is connected with this process or not is hard to decide. The whole process certainly has the appearance of a very simple reflex action, so that a consciousness, in the human sense can hardly be assumed.

Geographical Distribution.

East Coast of Australia, Port Jackson. (Ramsay, von Lendenfeld.)

Bathymetrical Distribution.

10-40 metres.

The specimens from greater depth appear to possess longer villi and a more massive shape, those from shallow water are more flattened and more smooth.

As the sponge, however, appears to be rare I am not able to establish any bathymetrical varieties from the observations at my disposal. Nardorus and Auloplegma forms have been dredged from all these depths.

Varieties.

There are, as mentioned above no great varieties in the shape of this sponge. Some possess Pseudoscula as described, whilst others are Aulaplegmaforms. I propose to establish two varieties for this species accordingly.

I. AULENA VILLOSA AULOPLEGMA,

WITHOUT PSEUDOSCULA.

II. AULENA VILLOSA NARDORUS,

WITH PSEUDOSCULA,

65. SPECIES.

AULENA FLABELLUM, NOVA SPECIES.

This species has been obtained only as Auloplegma, without Pseudoscula.

SHAPE AND SIZE.

As indicated by the specific name this species is flat, extended, frondose and fan-shaped with a short peduncle. The sponge does not seem to grow to any large size. The largest specimens measure 40 mm. in height, 50 mm. in width ; and the plain fan which they form has a thickness of 4-6 mm. The peduncle is circular cylindrical 4 mm. high, and in the central thinnest portion 8 mm. thick,

COLOR.

Alive in spirits and dry of nearly the same colour, always dirty grey.

SURFACE.

The villi are disposed in a somewhat regular manner, so as to form straight lines, which radiate towards the margin from the top of the peduncle. Otherwise this species represents Aulena villosa very closely in the structure of its surface.

STRUCTURE.

The internal structure is closely allied to that of the foregoing species, the skeleton indicates however, a tendency to form main radiating fibres in this way, that at certain intervals, portions of the uniform network of threads are slightly thickened (Plate XXXV., fig. 25.) From joint to joint such fibres are thickened, which lie in a radiating line, and so a main fibre is indicated.

This fibre retains however, the crooked coarse of the fibres by the thickening of which it has been formed and never contains foreign bodies.

Geographical Distribution.

East Coast of Australia, Port Jackson (Von Lendenfeld, Ramsay); Broughton Island (Ramsay).

Bathymetrical Distribution.

From 0-50 meters in Port Jackson, in shallow water at Broughton Island.

The shallow water specimens from Broughton Island are the largest, and present the most regular fan-like shape.

66. SPECIES.

AULENA NIGRA, NOVA SPECIES.

Only Aulophlegma forms without Oscula have been obtained,

Shape and Size.

This sponge is Chaliniform in as much as it presents the shape of a much curved circular cylinder about 8 mm. in diameter. Generally several cylinders of this kind grow out from an irregularly lobed basal mass. They rarely coalesce for a short distance. Every one however, retaining its individuality. The cylinders grow to a length of 50 mm. In the largest specimen there were five cylinders extending in the same direction, the largest of which measured 8 x 50 mm.

Surface.

The villi are shorter and more rigid than in either of the foregoing species, about 1 mm. high, 1 mm. thick and 1-5 mm. apart from one another.

Color.

The sponge is in spirits intensely black, as the specific name implies. In the interior it has a dark brownish grey color. The black pigment is found in the surface only.

Structure.

Main radiating fibres are still more developed than in the foregoing species. They have been formed apparently by local thickenings of the originally uniform network, but they are nearly straight, broken and abruptly bent only here and there, about twice as thick as the other fibres, which are similar to those of Aulena villosa (Plate XXXV., fig. 26.) These main fibres contain no foreign bodies. They are very rare, about 0·6 mm. apart from one another. They are not found in the villi.

Geographical Distribution.

East Coast of Australia, Port Denison, Queensland (Ramsay.)

Bathmetrical Distribution.

Shallow water, to 20 metres.

29. GENUS HALMOPSIS, (1) NOUM GENUS.

Auleninæ with secundary diaphragm lamellæ in the vestibule space, which consist like Aulena of a reticulate sponge structure. The terminations of the fibres project, as in that genus beyond the surface of the sponge forming villi. The skeleton consists of radiating main fibres, which are straight and completely filled with foreign bodies and tangental, connecting fibres, which have a diameter one-tenth that of the main fibres.

These fibres are clear and contain no foreign bodies.

This genus is intermediate between Aulena and Halme. Similar to the first in the high development of its vestibule cavity and similar to the second in the formation of the skeleton.

67. SPECIES.

HALMOPSIS AUSTRALIS, NOVA SPECIES.

Only Auloplegmaforms have been observed.

Shape and Size.

This sponge resembles Aulena villosa in outer appearance pretty closely. The usual shape is that of a flattened sphere. The sponge

(1) Halmopsis = deceptively like Halme.

attains a height of 30 and a horizontal diameter of 60 mm. A vertical section appears oval, a horizontal one circular. As stated above no specimens have been seen by me with a Pseudosculum, all are Auloplegmaform.

Color.

Alive, in spirits and dry this sponge is gray. In the dry state of a lighter hue than otherwise. In the interior the color is a little darker than on the surface.

Surface.

The surface is very similar to that of Aulena Villosa. The villi are scattered and not disposed in lines. They are long and slender and very close together, attaining a height of 2-3 mm., and a diameter of 0·8-1·2 mm. They are on an average 1 mm., apart.

Structure.

The peculiarities of the internal structure have been referred to above in the diagnosis of the genus. The skeleton is very similar to that of Halme and evidently our sponge in this respect forms a connecting species between Aulena nigra and the Halme species.

The structure of the sponge body, the development of diaphragm-membranes in the vestibule, etc., on the other hand closely resemble those structures in Aulena. The soft part and the histological structure likewise resemble Aulena very closely.

Geographical Distribution.

East Coast of Australia, Port Jackson (Von Lendenfeld).

Bathymetrical Distribution.

20-40 metres.

EXPLANATION OF PLATES,

Plate XXVI.

Fig. 1.—Halme Nidus Vesparum. R. v. L. Bulbous Form with small pores from Port Jackson. Drawn from life. Natural size.

Fig. 2.—Halme Nidus Vesparum. R. v. L. Form with finger-shaped processes, with larger polygonal pores from Port Stephens. Drawn from a spirit specimen. Natural size.

Fig. 3.—Halme simplex. R. v. L. Brown specimen with wide lacunæ from Torres Straits. Drawn from a spirit specimen. Natural size.

Plate XXVII.

Fig. 4.—Halme Nidus Vesparum. R. v. L. Transverse section through the specimen represented in fig. 1, the bulbous variety. Drawn from a thick section. Natural size.

Fig. 5.—Halme Nidus Vesparum. R. v. L. Transverse section through a specimen of the finger shaped variety, represented in fig. 2. Drawn from a thick section. Natural size.

Fig. 6.—Halme simplex. R. v. L. Transverse section through the specimen represented in fig. 3. Drawn from a thick section. Natural size.

Fig. 7.—Halme Nidus Vesparum. R. v. L. Transverse section through one of the finger shaped processes of the specimen represented in fig. 2. Alcohol alum-carmine specimen. Taken from one of a series of sections. Magnified 50:1. (*O*). Portion of the outer surface of the sponge. (*I*). Portion of an internal lamella. (*P*). Pores of the inhalent canal system. (*T*). Large foreign bodies, sand granules, forming a dermal armor on the exposed outer surface. (*f*). Small foreign bodies, mostly sand granules forming a dermal layer on the surface of the internal lamellæ. (*s*). Subdermal cavities of the inhalent canal system. (*e*). Inhalent canals. (*a*). Exhalent canals. (*H*). Radial, knobby main fibres, which are filled with large sand granules similar to those in the external cortex. (*V*). Tangental, solid and slender connecting fibres which are free from foreign bodies. (*G*). Ciliated Chambers.

Plate XXVIII.

Fig. 8.—Halme Nidus Vesparum. R. v. L. Portion of the skeleton in the interior of the sponge (the skeletons of the differently shaped

varieties are not different from one another.) Specimen macerated in fresh water. Magnified 35:1. (*H*). Radial main fibres with large sand granules in dense masses in the centre. (*V*). Hyaline tangental connecting fibres free from foreign bodies.

Fig. 9.—Halme Nidus Vesparum. R. v. L. Surface view of a pore in the outer surface of the external lamellæ with sieve membrane at the commencement of an inhalent canal. Osmic acid-alcohol specimen. Magnified 700:1.

Fig. 10.—An Oscillaria which is generally found in abundance in the outer surface of the external lamella of Halme species. Drawn after life from a teased portion of the sponge. Magnified 2,000:1.

Fig. 11.—Halme Nidus Vesparum. R. v. L. Portion of a longitudinal section, showing the ciliated chambers in the dividing membrane. Alcohol-alum carmine specimen. Magnified 850:1. (*E*). Inhalent canals. (*A*). Exhalent canal. (*P*). Chamber pores (inhalent). (*O*). Chamber osculum (exhalent aperture in the chamber wall). (*V*). A very fine connecting fibre cut through. (*S*). Stellate tissue cells. (*G*). Ciliated chambers.

Plate XXIX.

Fig. 12.—Halme Nidus Vesparum. R. v. L. Longitudinal section through portion of the finger shaped variety represented in fig. 1. Combined picture. Magnified 35:1. (*O*). An osculum. (*P*). Pores to the inhalent canals.

Fig. 13.—Halme Nidus Vesparum. R. v. L. Axial section through a ciliated chamber. Osmic-acid specimen teased out. Combined picture. Magnified 2,000:1. (*E*). Inhalent canal. (*A*). Exhalent canal. (*P*). Inhalent chamber pores. (*O*). Exhalent chamber pores. (*S*). Stellate tissue cells. (*d*). Flat epithel cells of the canals.

Plate XXX.

Fig. 14.—Aulena villosa. R. v. L. A specimen with radial villi and spherical in shape seen from above from a depth of 30 meters Drawn after life. Natural size.

Fig. 15.—Aulena villosa. R. v. L. Side view of a specimen with ascending villi of oval shape from a depth of 40 meters. Drawn from life. Natural size.

Fig. 16.—Aulena villosa. R. v. L. Surface view of the outer horny membrane covering one of the large sand granules in the skeleton, from a specimen macerated in fresh water. Magnified 1,000:1.

Fig. 17.—Aulena villosa. R. v. L. Margin of a particularly large sand grain of the skeleton from a specimen macerated in fresh water. Magnified 400:1. (*H*). Horny fibre. (*M*). Horny membrane. (*A*). Axial canal of the horny fibre.

Fig. 18.—Aulena villosa. R. v. L. Transverse section through a horny fibre just below the point of growth. Osmic-acid alum carmin specimen. Magnified 1,000:1. (*A*). Axial canal. (*H*). Stratified horny substance. (*S*). Coating of spongoblasts. (*B*). Tissue coating. Transverse section through the longitudinal, spindle-shaped tissue cells. (*B'*). A tissue thread consisting of spindle shaped tissue cells which attaches itself to the tissue coating of the horny fibre

PLATE XXXI.

Fig. 19.—Aulena villosa. R. v. L. Section through the outer portion of the sponge. Alcohol-alum-carmin specimen. Drawn from a thick section. Magnified 10:1. (*L*). Lacunose tissue of the vestibule. (*S*). The reticulate body of the sponge itself. (*S'*). Free portions of the sponge body projecting beyond the surface—rounded conuli.

Fig. 20.—Aulena villosa. R. v. L. Longitudinal axial section through the specimen represented in fig. 14. Drawn from a spirit specimen cut in two. Natural size.

PLATE XXXII.

Fig. 21.—Aulena villosa. R. v. L. Radial section through the distal portion of the sponge. Two conuli are cut through and appear extending beyond the lacunose tissue of the vestibule. Combined picture. Magnified 50:1.

PLATE XXXIII.

Fig. 22.—Aulena villosa. R. v. L. Skeleton of the distal portion of the sponge. Macerated in fresh water. Drawn from a thick section made by hand. Magnified 50:1. (*L*). Lacunose system of the vestibule. (*S*). Portions of the real sponge tissue. (*S'*). Free projecting portions (conuli.)

Plate XXXIV.

Fig. 23.—Aulena villosa. R. v. L. Section through a portion of the sponge in the interior. Osmic acid picro carmin specimen. (Cilia, collare and amœboid wandering cells from teased specimens after life.) Magnified 900:1. (*L*). Lacunæ of the vestibule. (*P*). An inhalent pore. (*S*). Sieve membrane. (*s*). Subdermal cavity. (*E*). Inhalent canal. (*A*). Exhalent canal, (*p*). Chamber pores. (*o*). Chamber oscula. (*G*). Ciliated chambers. (*H*). Horny fibre. (*a*). Spongoblasts. (*b*). Amœboid wandering cells. (*c*). Elongate, spindle shaped cells of a muscular and connective nature. (*d*). Ectodermal flat epithelium. (*e*). Entodermal flat epithelium. (*f*). Sensitive cells in the thickenings at the locality where the lamellæ of the vestibule join. (*T*). Palpocils. (*G*). Ganglia cells.

Plate XXXV.

Fig. 24.—Aphrodite Nardorus. R. v. L. Longitudinal section through the sponge. Half the natural size drawn from a spirit specimen cut in half. (*O*). Pseudoscolum. (*o*). Oscula. (*A*). Exhalent canals. (*P*). Pseudogaster.

Fig. 25.—Aulena flabellum. R. v. L. Portion of the skeleton from a specimen macerated in fresh water. 20:1. (*H*). Main fibres. (*V*). Connecting fibres.

Fig. 26.—Aulena nigra. R. v. L. Portion of the skeleton from a specimen macerated in fresh water. 20:1. (*H.*) Main fibre. (*V*). Connecting fibre.